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EXAMINER	
MONBLEAU, DAVIENNE N	

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2878	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/713,242	Applicant(s) SHIELDS ET AL.	
	Examiner Davienne Monbleau	Art Unit 2878	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 May 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-4,17-35 and 56-65* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4,17-35 and 56-65* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *21 May 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

The amendment filed on 5/21/04 has been entered. Claims 1-4, 18-22, and 30-34 have been amended. Claims 5-16 and 36-55 have been canceled. New Claims 56-65 have been added. Claim 35 was previously withdrawn from consideration. Claims 1-4, 17-35 and 56-65 are pending. An action on the merits for Claims 1-4, 17-34 and 56-65 follows.

Drawings

The drawings were received on 5/21/04. These drawings are accepted.

Claim Objections

Claim 59 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Independent Claim 57 recites the limitation "wherein the supply means comprises a source of pulsed incident radiation." Claim 59 recites the limitation "wherein the supply means comprises pulsed radiation." This is a broader limitation and thus fails to narrow Claim 57.

Claims 60-62 are objected to as being dependent on an objected base claim.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1-4, 17, 18, 20 and 22-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over the Applicant's cited prior art Molotov et al. ("Quantum Cryptography Based on Quantum Dots") in view of Sugiyama (US 6,177,684).

Regarding Claim 1, *Molotkov* teaches in Figure 1a and on page 688 a photon source comprising a quantum dot having a first confined energy level (valence band) and a second confined energy level (conduction band) and supply means (circular polarized photon) for supplying carriers to the said energy levels, wherein the supply means are configured to supply a predetermined number of carriers to at least one of the energy levels to allow recombination of a predetermined number of carries in said quantum dot to emit at least one photon. *Molotkov* does not teach that said supply means is electrical. *Sugiyama '684* teaches in Figure 6 a photon source comprising quantum dots (26a and 26b) and electrical supply means (31 and 32). It would have been obvious to one of ordinary skill in the art at the time of the invention to use electrical supply means in *Molotkov*, as taught by *Sugiyama '684*, to efficiently and directly pump the quantum dot region and minimize loss of the pump source.

Regarding Claims 2 and 3, *Molotkov* teaches on page 688, 3rd and 4th paragraphs the typical radiative recombination times and that the supply means needs to be controlled according in order to allow a single photon to be emitted. This enables predetermining the number of carriers to be injected, the time required to allow a certain amount of photons to be emitted, and the number of radiative recombinations that are possible within a given time frame.

Regarding Claim 4, *Molotkov* teaches in Figure 2a that a plurality of quantum dots may be used.

Regarding Claim 17, *Molotkov* teaches supplying carriers to one of the energy levels. It would have been obvious to one of ordinary skill in the art at the time of the invention to supply carriers to the other energy level since recombination may be achieved through either energy level.

Regarding Claim 18, *Molotkov* does not teach the energy level of the carriers. However, in order for the process of recombination to work, injected carriers into one energy level must have the energy of the other energy level; this allows for the transition.

Regarding Claim 22, *Molotkov* does not teach a mirror cavity. *Sugiyama '684* teaches in figure 7 and in column 10 lines 34-43 a mirror cavity having a mirror (M and AR) located on opposing sides of a quantum dot (26b). It would have been obvious to one of ordinary skill in the art at the time of the invention to use a mirror cavity in *Molotkov*, as taught by *Sugiyama '684*, to form an optical cavity of a laser diode which can produce an amplified optical beam.

Regarding Claims 20 and 23, *Molotkov* does not teach an anti-reflection coating located on the output surface. *Sugiyama '684* teaches an output surface (the right side of the device) and said mirror closest to said output surface is partially reflective (AR coating). It would have been

obvious to one of ordinary skill in the art to use an anti-reflective coating in *Molotkov*, as taught by *Sugiyama '684*, to prevent external/unwanted light from entering the device and altering the output beam.

Regarding Claim 24, *Molotkov* in view of *Sugiyama '684* does not teach the energy of the cavity mode. However, it is well known in the art that the energy of the cavity mode is substantially equal to the optical output beam because the energy of the cavity mode determines in effect the energy of the output beam.

Regarding Claim 25, *Molotkov* in view of *Sugiyama '684* does not teach the cavity length. However, it would have been obvious to one of ordinary skill in the art at the time of the invention to choose a specific distance between the two mirrors to achieve a desired cavity length since it is well known in the art that the length of a cavity directly affects the output wavelength of the optical beam. Furthermore, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Regarding Claim 26, *Molotkov* in view of *Sugiyama '684* does not teach the spectral band-pass of the cavity. However, it would have been obvious to one of ordinary skill in the art at the time of the invention to use a specific spectral band-pass of the cavity since it is well known in the art that the spectral band-pass directly determines the spectral width of the radiation that is emitted from the dot. Furthermore, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Regarding Claim 27, *Molotkov* in view of *Sugiyama '684* does not teach the position of the quantum dot. However, it would have been obvious to one of ordinary skill in the art at the time of the invention to place the quantum dot at a specific location within the standing wave pattern of the mirrors to provide the maximum gain from the quantum dot. Furthermore, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Claims 19, 21, and 30-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Molotkov* in view of *Sugiyama '684*, as applied to Claim 1 above, and in further view of Crow (US 5,423,798).

Regarding Claim 19, it is inherent that the photon source has an output surface but *Molotkov* does not teach coupling means including a fiber optic. *Crow* teaches in Figure 4 the output of a light source (the light transmitted through element 36) coupled to a fiber optic cable (42). It would have been obvious to one of ordinary skill in the art at the time of the invention to use couple the output into a fiber optic cable in *Molotkov*, as taught by *Crow*, to use the source in a communications system.

Regarding Claim 21, *Molotkov* does not teach a lens. *Crow* teaches in Figure 3 that the output of a light source (12) is collected in a lens (16). (42). It would have been obvious to one of ordinary skill in the art at the time of the invention to use a lens in *Molotkov*, as taught by *Crow*, because lenses are standard in the art to collect and focus output light.

Regarding Claim 30, *Molotkov* does not teach coupling means including a fiber optic. *Crow* teaches in Figure 4 the output of a light source (the light transmitted through element 36) coupled to a fiber optic cable (42). It would have been obvious to one of ordinary skill in the art

at the time of the invention to use couple the output into a fiber optic cable in *Molotkov*, as taught by *Crow*, to use the source in a communications system.

Regarding Claim 31, *Molotkov* does not teach a fiber optic cable. *Crow* teaches in Figure 4 the output of a light source (the light transmitted through element 36) coupled to a fiber optic cable (42). It would have been obvious to one of ordinary skill in the art at the time of the invention to use couple the output into a fiber optic cable in *Molotkov*, as taught by *Crow*, to use the source in a communications system. Furthermore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have the wavelength of the fiber equal to that of the cavity mode in order to maintain the output wavelength of the light source.

Regarding Claim 32, *Molotkov* in view of *Crow* does not teach an anti-reflection coating. It would have been obvious to one of ordinary skill in the art at the time of the invention to have a non-reflective coating on the fiber in order to maintain the desired output wavelength of the light source.

Regarding Claim 33, *Molotkov* does not teach a filter. *Crow* teaches in Figure 4 various optical elements to achieve a specific output beam, but does not specifically teach a filter. However, it would have been obvious to one of ordinary skill in the art at the time of the invention to use a filter in *Molotkov* to select a desired output wavelength (or to select any other feature) for the output beam. Filters are well known and commonly used in the art.

Regarding Claim 34, *Molotkov* does not teach a polarizer. *Crow* teaches in Figure 4 a polarizer (30). It would have been obvious to one of ordinary skill in the art at the time of the invention to use a polarizer in *Molotkov*, as taught by *Crow*, to select a desired output polarization for particular communication purposes.

Claims 28 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Molotkov* in view of *Sugiyama '684*, as applied to Claim 22 above, and in further view of Cho et al. (US 5,314,838).

Regarding Claim 28, *Molotkov* does not teach a Bragg mirror. *Cho* teaches in Figure 1 laser comprising a mirror cavity with a Bragg mirror (70) with alternating layers. It would have been obvious to one of ordinary skill in the art at the time of the invention to use a Bragg mirror in *Molotkov*, as taught by *Cho*, to create an efficient resonant cavity with minimum loss.

Regarding Claim 29, *Molotkov* does not teach a mirror comprising a metal layer and a phase matching layer. *Cho* teaches in column 2 lines 1-7 and in Figure 3 that a mirror may comprise a metal layer and a phase matching layer (80). It would have been obvious to one of ordinary skill in the art at the time of the invention to use a metal layer and a phase matching layer in *Molotkov*, as taught by *Cho*, to enhance the reflectivity of a metalized reflective surface and to enhance the constructive interference between reflected light, respectively.

Claim 56 is rejected under 35 U.S.C. 103(a) as being unpatentable over *Molotkov* in view of *Sugiyama '684*, as applied to Claim 1 above, and in further view of Sugiyama (US 6,281,519). *Molotkov* does not teach that said quantum dot is encapsulated between two adjacent layers having different lattice constants than the quantum dot. *Sugiyama '519* teaches in Figure 8 and in column 10 lines 35-46 a semiconductor device comprising a quantum dot (15) encapsulated between two adjacent layers (14 and 16) that have different lattice constants from said quantum dot (15). It would have been obvious to one of ordinary skill in the art at the time of the invention to encapsulate the quantum dot in *Molotkov*, as taught by *Sugiyama '519*, to have

spontaneous alignment in the direction generally perpendicular to the principal surface of the substrate. (See *Sugiyama '519* column 10 lines 29-34.)

Claims 57-63 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Molotkov* in view of *Sugiyama '519*.

Regarding Claim 57, *Molotkov* teaches in Figure 1a and on page 688 a photon source comprising a quantum dot having a first confined energy level (valence band) capable of being populated with a first carrier which is an electron and a second confined energy level (conduction band) capable of being populated with a second carrier which is a hole and supply means (pulsed incident circular polarized radiation) for supplying carriers to the said energy levels, wherein the supply means are configured to supply a predetermined number of carriers to at least one of the energy levels to allow recombination of a predetermined number of carries in said quantum dot to emit at least one photon. *Molotkov* does not teach that said carriers are resonantly excited or that said quantum dot is encapsulated between two layers having different lattice constants than the quantum dot. *Sugiyama '519* teaches in column 5 lines 60-65 resonantly exciting the carriers. It would have been obvious to one of ordinary skill in the art at the time of the invention to resonantly excite the carriers in *Molotkov*, as taught by *Sugiyama '519*, to cause an efficient dissipation of the electrons to the accumulation layer. (See *Sugiyama '519* column 6 lines 4-12.) *Sugiyama '519* further teaches in Figure 8 and in column 10 lines 35-46 a semiconductor device comprising a quantum dot (15) encapsulated between two adjacent layers (14 and 16) that have different lattice constants from said quantum dot (15). It would have been obvious to one of ordinary skill in the art at the time of the invention to encapsulate the quantum dot in *Molotkov*, as taught by *Sugiyama '519*, to have spontaneous alignment in the

direction generally perpendicular to the principal surface of the substrate. (See *Sugiyama '519* column 10 lines 29-34.)

Regarding Claim 58, *Molotkov* teaches on page 688, 3rd and 4th paragraphs the typical radiative recombination times and that the supply means needs to be controlled according in order to allow a single photon to be emitted. This enables predetermining the number of carriers to be injected, the time required to allow a certain amount of photons to be emitted, and the number of radiative recombinations that are possible within a given time frame.

Regarding Claim 59, *Molotkov* teaches on page 688, 4th paragraph line 3 that the supply means comprises pulsed radiation.

Regarding Claims 60-62, *Molotkov* teaches on page 688, 4th paragraph that the pulse has a duration less than the relaxation time of a carrier which it excites in the quantum dot. This ensures the separation of the stimulated photon emission.

Regarding Claim 63, *Molotkov* teaches in Figure 1a and on page 688 a photon source comprising a quantum dot having a first confined energy level (valence band) capable of being populated with a first carrier which is an electron and a second confined energy level (conduction band) capable of being populated with a second carrier which is a hole and supply means (pulsed incident circular polarized radiation) for supplying carriers to the said energy levels, wherein the supply means are configured to supply a predetermined number of carriers to at least one of the energy levels to allow recombination of a predetermined number of carries in said quantum dot to emit at least one photon. *Molotkov* does not teach that said carriers are resonantly excited or that said quantum dot is encapsulated between two layers having different lattice constants than the quantum dot. *Sugiyama '519* teaches in column 5 lines 60-65

resonantly exciting the carriers. It would have been obvious to one of ordinary skill in the art at the time of the invention to resonantly excite the carriers in *Molotkov*, as taught by *Sugiyama '519*, to cause an efficient dissipation of the electrons to the accumulation layer. (See *Sugiyama '519* column 6 lines 4-12.) *Sugiyama '519* further teaches in Figure 8 and in column 10 lines 35-46 a semiconductor device comprising a quantum dot (15) encapsulated between two adjacent layers (14 and 16) that have different lattice constants from said quantum dot (15). It would have been obvious to one of ordinary skill in the art at the time of the invention to encapsulate the quantum dot in *Molotkov*, as taught by *Sugiyama '519*, to have spontaneous alignment in the direction generally perpendicular to the principal surface of the substrate. (See *Sugiyama '519* column 10 lines 29-34.)

Claims 64 and 65 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Molotkov* in view of Farfard (US 6,768,754).

Regarding Claim 64, *Molotkov* teaches in Figure 1a and on page 688 a photon source comprising a quantum dot having a first confined energy level (valence band) capable of being populated with a first carrier which is an electron and a second confined energy level (conduction band) capable of being populated with a second carrier which is a hole and supply means (pulsed incident circular polarized radiation) for supplying carriers to the said energy levels, wherein the supply means are configured to supply a predetermined number of carriers to at least one of the energy levels to allow recombination of a predetermined number of carries in said quantum dot to emit at least one photon. *Molotkov* further teaches on page 690 that said photon source may comprise a plurality of quantum dots, each having a different size which results in different energies. *Molotkov* does not teach a filter. *Farfard* teaches in Figure 2 a

quantum dot laser comprising a plurality of quantum dots (72 and 73) a filter (50). It would have been obvious to one of ordinary skill in the art at the time of the invention to use a filter in *Molotkov*, as taught by *Farfard*, to let only the desired wavelengths resonate in the laser cavity or emit from the source.

Regarding Claim 65, *Molotkov* teaches in Figure 1a and on page 688 a photon source comprising a quantum dot having a first confined energy level (valence band) capable of being populated with a first carrier which is an electron and a second confined energy level (conduction band) capable of being populated with a second carrier which is a hole and supply means (pulsed incident circular polarized radiation) for supplying carriers to the said energy levels, wherein the supply means are configured to supply a predetermined number of carriers to at least one of the energy levels to allow recombination of a predetermined number of carries in said quantum dot to emit at least one photon. *Molotkov* further teaches on page 690 that said photon source may comprise a plurality of quantum dots, each having a different size which results in different energies. *Molotkov* does not teach selectively injecting/exciting only one quantum dot. *Farfard* teaches in Figure 2 a quantum dot laser comprising a plurality of quantum dots (72 and 73) a filter (50). Although *Farfard* does not specifically teach selectively injecting/exciting only one quantum dot, the filter has the same result by allowing only the desired wavelength to be emitted from the photon source. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to selectively injecting/exciting only one quantum dot in *Molotkov*, as suggested by *Farfard*, to let only the desired wavelengths be emitted from the photon source. Since each quantum dot has a different energy, each quantum dot would emit light at a different wavelength which directly corresponds to that energy. Thus,

selectively injecting/exciting only one quantum dot with a particular energy, which would emit light at a particular wavelength, has the same result as filtering out a particular wavelength after all quantum dots have been injected/excited.

Response to Arguments

Applicant's arguments with respect to claims 1-4, 17-35 and 56-65 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Davienne Monbleau whose telephone number is 571-272-1945. The examiner can normally be reached on Mon-Fri 9:00 am to 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Dave Porta can be reached on 571-272-2444. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Davienne Monbleau

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